1 WHAT IS CLAIMED IS: 2 3 A method of making a semiconductor heterostructure, comprising 4 the steps of: 5 a) providing a substrate; 6 b) forming a nitride buffer layer on the substrate to form a 7 buffer-layered substrate, wherein the buffer layer is formed 8 by a first deposition technique; and c) forming an nitride epitaxial layer on the buffer layer, $\Box 0$ wherein the epitaxial layer is deposited by a second 111 deposition technique, and the second deposition technique is <u>.1</u>2 different from the first deposition technique. <u></u>13 **եմ**, 1 2. The method of claim 1, wherein said step b) comprises forming 几 以 2 the buffer layer by MOCVD. The method of claim 1, wherein said step c) comprises forming 3. 2 the epitaxial layer by hydride vapor-phase epitaxy. 3 The method of claim 1/1, wherein the epitaxial layer comprises a 1 4. nitride of an element of groups III and IV of the periodic 2 3 table. 4 The method of claim 1, wherein the substrate comprises a 1 5. material selected from the group consisting of sapphire, 2

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layer comprises aluminum nitride, ZnO, MgO and GaN.

silicon, silicon/carbide, and gallium arsenide, and the buffer

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1	6.	The method of claim 1, wherein the epitaxial layer comprises
2		metal nitride comprising at least one metal selected from the
3		group consisting of gallium, aluminum and indium.
4		
1	7.	The method of claim 1, wherein the buffer layer has a thickness
2		in the range of 1.0 nanometer to 1.0 micron.
3		
₋ 1	8.	The method of claim 1, wherein the epitaxial layer has a
_ 		thickness of at least 1 micron to 500 micron.
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4 1	9.	The method of claim 1, further comprising the step of:
□ 2		d) in lieu of said step c) and after said step b), forming a cap
⊢ 3		layer on the buffer layer; and
N 14 00		e) forming the epitaxial layer on the cap layer.
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1	10.	The method of claim 9, wherein said step d) is performed by
2		MOCVD and said step e) is performed by HVPE.
3		
1	11.	The method of claim 9, wherein the cap layer comprises a nitride
2		of an element of groups III and IV of the periodic table.
3		
, 1	12.	The method of claim 9, wherein the cap layer and the epitaxial
2		layer each comprise a metal nitride comprising at least one
3		metal selected from the group consisting of gallium, aluminum,
4		and indium.

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1	13.	The method of claim 1, wherein said step b) is performed in a
2		MOCVD chamber, and said step c) is performed in a HVPE reactor,
3		and said method further comprises the steps of:
4		f) after said step b), removing the buffer-layered substrate
5		from the MOCVD chamber; and
6 7		g) arranging the buffer-layered substrate in the HVPE reactor.
1	14.	A method of making a semiconductor heterostructure, comprising
_ 2		the steps of:
]2]3		a) providing a substrate;
<u>4</u>		b) forming a buffer layer on the substrate to form a buffer-
년4 급5		layered substrate;
_ 6		c) forming a cap layer on the buffer layer; and
4 7		d) forming an epitaxial layer on the cap layer, wherein the
Ū8		buffer layer and the capping layer are formed by CVD and the
≟ 9		epitaxial layer is formed by HVPE.
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1	15.	The method of claim 14, wherein said step d) is replaced by
2		forming the epitaxial layer on the cap layer, wherein the buffer
3		layer and the capping $\lim_{1}^{1/2}$ are formed by MBE and the and the
4		epitaxial layer is formed by HVPE.
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1	16.	The method of claim 14, wherein said step c) is performed by a
2		process selected from the group consisting of MOCVD, MBE and
3		sputtering.
4		j'
1	17.	The method of claim 14, further comprising the step of:

2		e) removing a portion of the heterostructure from the substrate.
3		
1	18.	The method of claim 14, wherein the substrate comprises a
2		material selected from the group consisting of sapphire,
3		silicon, silicon carbide, and gallium arsenide; the buffer layer
4		comprises AlN; and the epitaxial layer comprises GaN.
5		
1	19.	The method of claim 14, wherein the buffer layer and the
= 2		epitaxial layer have a combined thickness in the range of 1.0
] 2] 3		micron to 500 micron.
4 D		
1 1	20.	The method of claim 14, wherein the epitaxial layer has a
		5 1 0 migraph to 500 migraph
2		thickness in the range of 1.0 micron to 500 micron.
13		thickness in the range of 1.0 micron to 500 micron.
1 13 1 1	21.	An epitaxial layer, comprising a metal nitride comprising a
4 13	21.	
13 13 13 13 13	21.	An epitaxial layer, comprising a metal nitride comprising a
U 3 U 1 U 2	21.	An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum
1 3 1 1 2 3	21.	An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vapor-
13 11 12 2 3	21.	An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vaporphase deposition on a buffer layer and wherein the buffer layer
13 11 2 2 3 4 5	21.	An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vaporphase deposition on a buffer layer and wherein the buffer layer comprises a nitride of an element of groups III or IV of the
13 11 2 2 3 4 5	21.	An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vaporphase deposition on a buffer layer and wherein the buffer layer comprises a nitride of an element of groups III or IV of the periodic table formed on a substrate by a method selected from
13 11 2 3 4 5 6 7	21.	An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vaporphase deposition on a buffer layer and wherein the buffer layer comprises a nitride of an element of groups III or IV of the periodic table formed on a substrate by a method selected from
13 11 2 3 4 5 6 7		An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vaporphase deposition on a buffer layer and wherein the buffer layer comprises a nitride of an element of groups III or IV of the periodic table formed on a substrate by a method selected from the group consisting of MOCVD, MBE or sputtering.
1 3 1 2 3 4 5 6 7 8 1		An epitaxial layer, comprising a metal nitride comprising a metal selected from the group consisting of gallium, aluminum and, wherein the epitaxial layer is formed by hydride vaporphase deposition on a buffer layer and wherein the buffer layer comprises a nitride of an element of groups III or IV of the periodic table formed on a substrate by a method selected from the group consisting of MOCVD, MBE or sputtering.

and the buffer layer together comprise an epitaxial layer/buffer

	3		layer heterostructure, and the epitaxial layer /buffer layer
	4		heterostructure is removed from the substrate.
	5 、		
	1	24.	A semiconductor heterostructure, comprising:
	2		a) a buffer layer, said buffer layer formed by MOCVD; and
	3		b) an epitaxial layer deposited on said buffer layer, said
	4		epitaxial layer formed by HVPE.
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	<u></u> 1	25.	The heterostructure of claim 24, wherein said buffer layer
			comprises a material selected from the group consisting of AlN,
	ы П П Ш 3		InN and GaN, and wherein said buffer layer has a thickness in
	₩ Ū4 ⊭		the range of from about 1.0 nanometer to 1.0 micron.
2	2 5		
D	= → 1	26.	The heterostructure of claim 25, wherein said epitaxial layer
	∏ ₩ 2		comprises a metal nitride comprising at least one metal selected
	□ 3		from the group consisting of Ga, Al and In and wherein said
	}		epitaxial layer has a thickness in the range of from about 1.0.
	5		micron to 500 micron.
	6		
	1	27.	An epitaxial layer prepared according to the method of:
	2		a) forming a buffer layer on a substrate by CVD;
	3		b) forming a cap layer on the buffer layer; and
	4		c) forming an epitaxial layer on the cap layer by hydride vapor-
	5		phase epitaxy.

1	28.	The epitaxial layer of claim 27, wherein the epitaxial layer
2		comprises a nitride comprising an element selected from group
3		III and group IV of the periodic table.
4		
1	29.	The epitaxial layer of claim 27, wherein the substrate comprises
2		a material selected from the group consisting of sapphire,
3		silicon, silicon carbide, gallium arsenide, zinc oxide and
4		magnesium oxide; and the buffer layer comprises aluminum
-5 6 		nitride.
_	30.	The epitaxial layer of claim 28, wherein the cap layer and the
IJ1 Ū ┵2 IJ 3		epitaxial layer have substantially the same composition.
Lj1	31.	The epitaxial layer of claim 26, wherein the cap layer and the
m52		epitaxial layer each comprise a nitride comprising an element
ŋ2] _3		selected from the group consisting of group III and group IV
4		elements of the periodic table.
5		
1	32.	The epitaxial layer of claim 27, wherein the cap layer is formed
2		by MOCVD